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Component placement device

The invention relates to a component placement device comprising an elongated transport device by means of which transport device in operation substrates to be provided with components can be moved in a transport direction parallel to the transport device, which component placement device further comprises at least one component feeder which is located along a longitudinal side of the transport device, as well as a component pick and place unit by means of which in operation a component can be picked up from the component feeder and placed on a substrate.

In such a component placement device known from international patent application WO 95/19099 component feeders are arranged on either one of the two longitudinal sides of the transport device.

By means of pick-and-place units components are picked up from the component feeders and placed on the substrates supported by the transport device.

The size of the substrate in a direction transverse to the transport direction depends, among other things, on the distance between the feeders located on either one of the two sides of the transport device. In order to keep the distance between the component feeders and the substrate shortest possible, the component feeders are preferably arranged as close to the transport device as possible. The size of the substrates which can be provided with components by the known devices is such that on the one hand a great variety of substrates can be provided with components by the same component placement device, whereas at the same time the distance between the component feeders and the substrates is shortest possible. In practice this means that relatively large substrates, a dimension of which in a direction extending transversely to the transport direction is relatively large, cannot be provided with components by means of the component placement devices known per se. Such substrates are then to be provided with components either by hand or a special component placement device is to be procured. The distance between the component feeders and the substrate is then relatively large. In addition, such a specific component placement

device is relatively expensive, takes up relatively much room and will be applied in relatively few cases at that.

Therefore, it is an object of the invention to provide a component placement device which is suitable in a relatively simple manner for components to be placed on relatively large substrates while at the same time components can efficiently be placed on customary substrates.

This object is achieved with the component placement device according to the invention in that the component placement device further comprises a substrate support situated along a longitudinal side of the transport device, which side faces away from the component feeder.

By means of the substrate support relatively large substrates can be supported on a side facing away from the component feeder. By means of the component pick-and-place unit or units, components are picked up from the component feeder and moved over the transport device to the substrate supported by the substrate support.

The substrates having relatively small, normal or customary sizes are moved through the component placement device in customary fashion by means of the transport device and provided with components by means of the pick-and-place unit.

The time required for placing the components on the customary substrates will not be affected or hardly be affected by the addition of the substrate support, while the substrate support is instrumental in providing the possibility to mount components on relatively large substrates in an efficient manner by means of an already available component placement device.

An embodiment of the component placement device according to the invention is characterized in that the substrate supports are detachably connected to the component placement device.

If the substrate support is detachably connected to the component placement device it is possible to remove the substrate support the moment when only customary substrates are to be provided with components. It is then possible for movable component feeders to be added to the component placement device once the substrate support has been removed, so that the number of different components that can be positioned on the substrate transported by means of the transport device is increased and also the speed at which the components can be mounted on the substrates is increased.

Another embodiment of the component placement device according to the invention is characterized in that the substrate support comprises driving means by which in operation a substrate can be moved in a feeding direction extending transversely to the transport direction.

A substrate supported by the substrate support can easily be moved in the transport direction by the driving means so that the substrate is located closest possible to the component placement device(s) located on the other side of the transport device at the time when components from the component placement devices are mounted on the substrate by means of the component pick-and-place unit.

Yet another embodiment of the component placement device according to the invention is characterized in that the transport device comprises at least one guide profile extending parallel to the transport direction, which profile is connected to the substrate support, the guide profile together with the substrate support being movable in a direction extending transversely to the transport direction.

In this manner it is possible to move the guide profile of the transport device in the direction of the component placement device, so that the width occupied by the transport device is limited. Moreover, at the same time the substrate support connected to the guide profile is also moved in the direction of the component feeder, so that the distance between the component feeder and the substrate support is diminished.

Yet another embodiment of the component placement device according to the invention is characterized in that the substrate support comprises two parallel guides which extend transversely to the transport direction.

By means of such guides it is possible in a simple manner to move a substrate to and from the component feeders and also to efficiently support a substrate.

If the distance between the guides is adjustable, the substrate support can be simply adapted to substrates of different sizes.

Yet another embodiment of the component placement device according to the invention is characterized in that the substrate support can be moved vertically from a position situated parallel to the transport device to a position underneath the transport device.

As a result of the vertically movable substrate support it is possible in a simple way to move the substrate support between a position in which the substrate support is situated parallel to the transport device, so that a substrate on which components can be mounted can be supported by the substrate support. The substrate support is further movable to a position underneath the transport device, where the substrate support is unfit for

supporting substrates but where the room above the substrate support is accessible for, for example, additional component feeders.

These and other aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter.

In the drawings:

Fig. 1 shows a state of the art plan view of a component placement device,

Fig. 2 shows a plan view of a first embodiment of a component placement device according to the invention,

Fig. 3 shows a plan view of a second embodiment of a component placement device according to the invention,

Fig. 4 shows a plan view of a third embodiment of a component placement device according to the invention,

Figs. 5A and 5B show plan views of a fourth embodiment of a component placement device comprising component feeders positioned between a substrate support and a substrate supported by the substrate support,

Fig. 6 shows a plan view of a further embodiment of a component placement device according to the invention,

Figs. 7A-7D show plan views of a substrate support and various driving means therefor, respectively.

Corresponding components in the drawing Figures carry like reference numerals.

Fig. 1 shows a state of the art component placement device 1 which comprises a frame 2, a transport device 3 supported by the frame 2, a beam 4 supported by the frame 2 and movable in and opposite to the direction indicated by the arrow Y as well as rows of component feeders 5 supported by the frame 2 and positioned along either one of the two sides of the transport device 3. The beam 4 supports a slide 6 which comprises a number of component pick-and-place units 7 which are movable relative to the beam 4 in and opposite to the direction indicated by the arrow X by means of the slide 6.

The transport device 3 comprises two guide profiles 8 extending in parallel to each other.

The operation of the state of the art component placement device 1 is as follows. A substrate 9 is supported by the guide profiles 8 and transported by the transport device 3 in the direction indicated by the arrow X through the component placement device 1. The component pick-and–place units 7 are moved in and opposite to the direction indicated by arrow X and also in and opposite to the direction indicated by the arrow Y between the various component feeders where components are picked up from the component feeders 5 by means of the component pick-and-place units 7. Subsequently, the component pick-and-place units 7 are consecutively taken to the desired positions on the substrate 9 where the components are mounted on the substrate 9 by means of the component pick-and–place units 7.

The maximum size B of the substrate 9 is determined by the maximum mutual distance between the guide profiles 8 of the transport device 3.

Consequently, substrates 9 having a size B which is, for example, twice or three times as large as the size shown in Fig. 1, cannot be provided with components by the transport device 3.

Fig. 2 shows a plan view of a first embodiment of a component placement device 11 according to the invention which largely corresponds to the device 1 shown in Fig. 1. The component placement device 11, however, has only one row of component feeders 5 on one side of the transport device 1. On a side of the transport device 3 facing away from the component feeders 5 the component placement device 11 comprises two guides 12 extending transversely to the transport device and indicated by the arrow X to support a relatively large substrate 13. Components are placed on the substrate 13 in a comparable manner to the component placement device 1 shown in Fig. 1. The area of the substrate 13 which can accommodate components is limited by the maximum displacement of the slide 6 in the direction opposite to the arrow Y relative to the frame 2. If the substrate area 14 situated as it were outside the component placement device 11 is also to be provided with components, the substrate 13 is to be turned around after it has partially been provided with components, after which the area 14 ends up close to the guide profiles 8.

The guides 12 forming the substrate support 15 can permanently be connected to the guide profiles 8, in which case the component placement device 11 is directly available for placing components on relatively large substrates 13. The distance between the guides 12 is preferably adjustable, so that substrates 13 of different sizes 11 can be simply supported by the guides 12. As is apparent from Fig. 2, the guide profile 8 situated close to the guides 12

has been moved relatively close to the other guide profile 8 of the transport device 3. As a result, the distance between the component feeders 5 and the substrate 13 is relatively small.

If components are to be placed on a relatively small substrate 8 by means of the component placement device 11, the guide profiles 8 are brought to such a mutual distance that the substrate 8 to be provided with components can be supported by the guide profiles 8, after which the substrate is transported by the component placement device 11 in the transport direction indicated by the arrow X in a similar manner to the one explained with reference to Fig. 1, in which components are picked up from the component feeders 5 and placed on the substrate by means of the component pick-and-place units 7.

If the guides 12 continue to be connected to the guide profile 8, only component feeders 5 can be used which are located on a side of the transport device 3 facing away from the guides 12. However, if the guides 12 are detachably connected to the component placement device, once the guides 12 have been removed, removable or movable component feeders 5 can be placed in the space falling vacant as a result of the removed guides 12, so that the component placement device 11 can function in a similar manner to the component placement device 1 shown in Fig. 1.

Fig. 3 shows another embodiment of a component placement device 21 according to the invention, which is distinguished from the component placement device 11 shown in Fig. 2 in that the guide profile 8 facing away from the component feeders 5 comprises a coupling strip 22 that has supports 23, 24 near either one of the two ends. The support 24 can be moved along the coupling strip 22 in the directions indicated by the double arrow P1, so that the mutual distance between the supports 23 and 24 can be simply adjusted. The supports 23, 24 are used for supporting the guides 12 which extend transversely to the guide profile 8 and the coupling strip 22 connected to it. On a side facing away from the guide profile 8, further supports 25, 26 are provided to render additional support to the guides 12 and the substrates 13 to be supported by the guides 12. The coupling strip 22, the supports 23-26 and the guides 12 together form a substrate support.

A substrate 13 is moved in the direction indicated by the arrow P2, supported by the guides 12 to the component feeders 5 either manually or by means of a substrate feeder until a head end of the substrate 13 abuts the coupling strip 22. Subsequently, components from the component feeders 5 are placed on the substrate 13 in a similar manner to the one explained with reference to the component placement device 11 shown in Fig. 2.

Fig. 4 shows a further embodiment of a component placement device 31 according to the invention, which largely corresponds to the component placement device 11

shown in Fig. 2. The component placement device 31 distinguishes itself from the component placement device 11 in that on a side facing away from the component feeder 5 there is a movable substrate support on wheels 32 which has an undercarriage on wheels 33 and a substrate holder 34 supported by the carriage 33. Components can be placed on the substrate 13 by means of the component pick-and-place units 7 in a similar manner to the one that is explained with reference to Fig. 2. Preferably, stops are provided in the component placement device 31 against which the undercarriage on wheels 33 can be accurately positioned in directions X, Y and Z.

The undercarriage on wheels 33 makes it possible to provide a relatively large substrate 13 with components in a relatively fast manner. Once the substrate 13 has been provided with components, the undercarriage on wheels 33 is removed and the thus available room is preferably taken up by a detachable row of component feeders 5.

Figs. 5A and 5B show yet another embodiment of a component placement device 41 according to the invention, which comprises two guides 42 which form a substrate support 43 and extend transversely to the guide profiles 8. The guides 42 each have two supports 44 relative to which the guides 42 can be moved in a direction Z extending transversely to the plane of the drawing. In the position shown in Fig. 5A the guides 42 are in relatively low position underneath the guide profiles 8 where the guides 42 do not cause any hindrance to the substrate 9 to be transported over the guide profiles 8.

Components are picked up from the component feeders 5 positioned on either one of the two sides of the transport device 3 and placed on the substrate 9 in the manner described above by means of component pick-and-place units 7.

If relatively large substrates 13 are desired to be provided with components by means of the component placement device 41, the row of component feeders 5 positioned between the guides 42 is temporarily removed. Then the guide profile 8 that is located above the guides 42 is moved in the direction of the other guide profile after which the guides 42 are moved in an upward direction Z relative to the supports 44 until the guides 42 are situated in the same plane as the guide profiles 8.

Subsequently, a substrate 13 on which components are placed in the manner already described above is put on the guides 42. In the device 41 the substrate support 43 therefore need not be removed completely, so that also relatively large substrates 13 can be provided with components in a relatively fast manner.

Fig. 6 shows yet another embodiment of the component placement device 51 according to the invention, which largely corresponds to the component placement device 21

shown in Fig. 3. The component placement device 51 distinguishes itself from the component placement device 21 in that component placement device 51 comprises a substrate holder 52 on which a substrate 13 is positioned at a location beside the component placement device. Subsequently, the substrate holder 52 is placed with positioning holes 53 over pins 54 protruding from the supports 23, 24. The substrate support 52 is supported by the supports 25, 26 on a side facing away from the support 23, 24.

After the substrate 13 has been inserted into the component placement device 51 in the manner described above, components from the component feeders 5 are placed on the substrate 13 by means of the component pick-and-place units 7.

Figs. 7A-7D show a plan view of a number of different side elevations of a substrate support 61. The substrate support 61 comprises at least two parallel guides 12 for supporting a substrate 13.

Fig. 7B shows a guide 12 comprising an endless conveyor belt 62 for transporting the substrate 13 in and opposite to the direction indicated by arrow Y.

Fig. 7C shows a guide 12 which comprises a relatively smooth support surface 63 over which the substrate 13 can be slid by hand in and opposite to the direction indicated by the arrow Y.

Fig. 7D shows a guide 12 comprising a strip 64 that supports an edge of the substrate 13, which strip has two grooves 65 extending in the direction Y. Pins 66 are situated in the grooves 65, which pins are each connected to a triangular coupling face 67. On another side the coupling face 67 is hingeably connected to a coupling rod 68 an end of which is connected to a piston 70 movable in a cylinder 69. By moving the piston 70 from the position shown in Fig. 7D in a direction opposite to the arrow Y, the coupling pieces 67 will be swiveled around shafts 71 as a result of which the strip 64 is moved in upward direction Z together with the substrate 13.

The size of the relatively large substrate 13 permitting, it is quite possible to place a single or a couple of component feeders 5 beside the substrate.